# AMORTIZATION

Both borrowers and lenders are giving keener attention to the amortization (extinction rather than conversion) of long-time loans. Railroads and industrials in this country will, it is said, soon require from four to five billions of dollars. The sums needed for federal, state, and municipal loans will also be enormous. Accepting the extinction of such loans as necessary, the study of the best way to secure such extinction is essential.

Progressive legislation thereon in Massachusetts is at last conclusive against the sinking fund method of repaying public loans. But now from England comes a profound treatise,[1] by Edward Hartley Turner, supporting the opposite view, not only for public loans, but for commercial or financial undertakings where the conditions are much more variable. A deeper interest in this far-reaching subject is thus aroused on both continents.

Mr. Turner is lecturer on municipal accounts at the Manchester (England) Municipal School of Commerce. In 1906 he was appointed the British accounting expert to the Commission on Public Ownership and Operation formed in New York by the National Civic Federation.

Mr. Turner claims that his elaborate work is entirely practical. It affects financial operations of the largest magnitude. It upholds amortization through sinking funds. It fulfills, however, a dual use; one curative, the other premonitory. The more profound its explication of sinking fund problems and the greater their stated number, the plainer is the warning to avoid them. The rocks and shoals of financial navigation are to be shunned rather than sought. The principles explained adapt the book both to public finance and to privately owned commercial and financial undertakings; to America as well as to Great Britain; and to any currency of a decimal nature. To American readers a special preface is addressed. An index contains nearly 2,000 references to the text, which is handsomely printed. The entire work is an achievement in substance and appearance; it is replete with the solution of problems incident to sinking funds. It admits that the sinking fund method is the most complex mode of repayment, and yet insists that it is "*by far the best*" (p. 135). It ignores the apothegm that prevention is better than cure; and that prevention should always have the

[1] *The Repayment of Local and Other Loans. Sinking Funds.* By Edward Hartley Turner. (New York: The Ronald Press Co. 1913. Pp. xxvii, 538. $6.)

first claim. As a treatise on sinking fund therapeutics it is probably unsurpassed; but its attempt to uphold the sinking fund method as supreme for the repayment of loans challenges the experience of both Europe and America. Its very merits tend to frustrate its author's cardinal aim.

The book is not a treatise on the laws of municipal loans. Statutory obligations thereon are very variable both in Great Britain and overseas. The general practice of Parliament and of government departments controlling such matters is not based, the author says, upon any well-defined principles. But the Local Government Board of England seeks to impose a uniform system, especially as to times for repaying loans for public works having longer or shorter periods of duration or continuing utility.

The life of the asset and the consequent period of repayment presents one of the most difficult of funding problems, both in municipal finance and in private undertakings, considering the extended and complicated nature of municipal and industrial activity, ever widening. "This variation in the life of the asset," the author says, "imports special difficulties into the problem, relating to the vexed question of the adequacy or otherwise of the sinking fund instalment as a provision for depreciation, obsolescence and supersession" (p. 346).

Mr. Turner insists that the modern parliamentary practice is right, namely, to require the redemption of public utility loans to be spread over a period well within the life of the asset created out of the loans, and to differentiate between various classes of outlay in fixing the period to be allowed for each (ch. 31). The same practice may be equally sound for private undertakings, even if the conditions thereof are much more variable and elastic, whereby the original arrangements between borrower and lender may be altered.

As the repayment, other than by the simple instalment method (p. 111), of loans spread over a period of years involves questions of compound interest (p. 2), the author first investigates the mathematical principles governing the annual or periodic accumulation of a present sum of money, and also of a sum of money payable or receivable at the end of each of equal and definitely recurring periods of time. All such problems follow the algebraical rule relating to geometrical progression; and the author's primary object becomes a conversion of that algebraical formula into a formula applicable to the main subject-matter of the book, namely,

compound interest. He adopts his own symbols, and in chapter 10 gives a detailed explanation thereof and of his formulae which deal with his standard calculation forms. Throughout the book the higher branches of mathematics are employed in the calculations, for which it is claimed that the ordinary methods of arithmetic are inadequate and that the aid of logarithms must be invoked even if the fullest use be made of the various published tables of compound interest. The final chapters deal with such pertinent subjects as the life of the asset, the equation of the period of repayment, and the incidence of taxation.

The following scheme arranges in groups some of the complex sinking fund problems which are mathematically treated by the author:

### The Annual Instalment

(1) A deficiency in the fund. Two variations.

(2) A surplus in the fund. Four variations. Remarks as to sinking funds of commercial and financial undertakings.

(3) The rate per cent. Three variations. Summaries of the methods of adjustment.

### The Annual Increment

(4) Problems relating to the rate per cent of accumulation.

(5) Problems relating to the redemption period.

(6) Problems combining the two preceding.

(7) Problems where the future variation in the rate of income is known and is definite.

(8) Problems where the future variation in the rate of income is anticipated, but is uncertain.

### The Date of Borrowing, and its Relation to the Redemption Period

(9) Loan for several years in one sum in each year, each loan payable in a prescribed period from the dates of borrowing:

    1. By one sinking fund only.

    2. By separate sinking funds for each year's loan.

(10) Loan for several years in one sum in each year, payable in one sum on a certain date:

    1. Where date of payment is known when the money is borrowed.

    2. Where date of payment is fixed after the sinking fund has operated for several years, and an adjustment of the fund is required.

(11) Loan for one or more years, in varying amounts and at various dates each year, and it is required that the revenue or rate account of each year be charged with a proportionate part of the annual sinking fund instalment.

An appendix to the book contains 68 standard calculation forms prepared by the author, to find the exact or approximate rate per cent, or number of years, in connection with each of 5 standard tables of compound interest as applied to a sum of money and to an annual or other periodic payment. Altogether this work, the result of years of experience, is a remarkable demonstration of some of the uncertainties, hazards, and difficulties that beset the archaic sinking fund method of repaying debts.[2]

According to Mr. Turner (p. 110), the English Public Health Act, of 1875, sec. 234, still furnishes the standard for methods of repaying public debts in Great Britain, and will apply equally to commercial and financial undertakings, as based upon general financial practice. Three alternative methods, at the option of the local authority, are specified, by which the loan debt may be repaid:

(1) The *Instalment Method*; by equal annual instalments of principal.
(2) The *Annuity Method*; by equal annual instalments of principal and interest combined.
} "Serial Bonds"

(3) The *Sinking Fund Method*; setting apart annually as a sinking fund to accumulate by compound interest such a sum as will, with accumulations by compound interest, pay off the principal of the loan within the prescribed period.

Of the first of these three methods Mr. Turner says: "The insalment [serial bond] method is exceedingly simple in operation, seeing that it is merely an arithmetical calculation, and does not involve any question of compound interest whatever" (p. 111).

There is a well recognized canon that the simpler and the easier finance is, "the nearer it is to perfection," yet Mr. Turner instead of recommending the instalment method which he affirms "is exceedingly simple in operation," finally concludes that:

Summing up the respective merits of the various methods of repayment of the debt of local authorities, it may fairly be concluded that the accumulating sinking fund method is *by far the best*. It [theoretically] bears equally upon the taxation or revenue of each year of the repayment period; and as regards the investor, it is at once more convenient and more equitable than either of the other two methods (p. 135).

The conclusions of Mr. Turner, however, should not be taken without careful analysis.

[2] Compare *The Use and Misuse of the Sinking Fund*, by P. D. Leake (London: Gee & Co. 1912); also in *The Accountant* (London), Nov. 23, 1912, pp. 663-669.

M. Trinquat, in his *De l'Amortisement des Emprunts d'Etats,*
published in Paris in 1899, wherein is a bibliography on sinking
funds, including ninety-six works in different languages, ac-
cepts the principle that finance should be so simple as to be
easily understood by all classes, and that the easier it is the nearer
it is to perfection (p. 381). He agrees with the eminent political
economist J. B. Say in that there are no two ways of extinguishing
debt; the *only way* is, for a state as for an individual, to use the
revenue above the expenses. Every other form of extinguishing a
debt is a pure folly, wherefrom no advantage accrues to the state
(p. 385). His opening chapters aim to show that morally, politi-
cally, and economically amortization of public debts is a necessity.
He maintains that for the public to free itself from the obligation
of paying debts is to encourage itself to incur infinitely new debts
(p. 78); and he quotes Ricardo, that sinking funds rather tend to
encourage expenditure, than to diminish debt (p. 209). And
Sargant wrote: A sinking fund "acts on the public as a narcotic,"
for "the confidence placed in the efficacy of these schemes has con-
tributed further to ease the alarm which the magnitude of the
public debt would otherwise have produced."[3] A still more modern
authority affirms that:

Whenever the financial condition of a nation warrants a repayment
of debt there are simpler methods of proceeding than sinking fund
arrangements. . . while it [a sinking fund] has been discarded in the
practice of the more advanced nations, it is sometimes used by nations
of weaker credit.[4]

And in Canada, Mr. Macpherson, of the Institute of Chartered
Accountants of Ontario, has pronounced "the day of the sinking
fund as past," insisting that, "with a thorough sense of the re-
sponsibility attaching to the position which I take, I have no
hesitation in saying that the sinking fund is a curse to the average
municipality. . . . By far the greater part of the debentures
issued at the present time are upon the instalment or annuity
plan."[5]

Mr. J. Hampden Dougherty, a member of the Charter Commis-
sion for a new charter for New York city, wrote to the "New York
Tribune" of April 12, 1909, that:

The theory of sinking funds as security for the payment of public
debts has become obsolete. . . . The Commission of 1908 favors the

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[3] *Sinking Funds,* p. 170.

[4] *New International Encyclopedia,* vol. VII, p. 617.

[5] Macpherson, *Municipal Accounting,* pp. 26, 28.

*abolition of all sinking funds,* which, however, may not be done without breach of contractual pledges, unless the city debt be *entirely refunded.* Great as the problem of refunding would be, it would be wise to attempt it and eliminate all sinking funds for the future. . . . The sinking funds are a clog upon the city's development. . . . From every point of view the perpetuation of the sinking fund system is unnecessary and costly.

While Mr. Turner's chapters on sinking fund problems are so elaborate, his general summary of all three methods of repaying debts (p. 140) is hardly adequate, for the tabular statement there given and printed hereinafter on page 886 is based upon a loan of only £1,000 repayable in the short term of 10 years. Mr. Turner fails to emphasize the enormous difference in the cost, and far greater difference in the interest account to the borrower or taxpayer, between these methods when applied to larger amounts for longer terms. The inadequacy of such limited illustrations of this phase of funding has often misled. As such transactions apply to hundreds of millions of dollars of loans, often running for 20, 30, 40, 50 and more years, a tabular statement of the great difference between the practical result to the taxpayers of the instalment or serial bond method and the sinking fund method in larger operations, is in justice obligatory and will be presented later in condensed form.

Furthermore, the sinking fund, which is supposed to earn enough to meet the principal of the debt, but which earns *no part of the interest,* that being often far greater than the principal, is subject to constant risks. It is notorious that sinking funds are often neglected, mismanaged, lost, made the scapegoat by being appropriated to other uses, and have been stolen. Even state constitutions and state laws to maintain the inviolability of sinking funds, are found to be inadequate to protect either creditor or debtor. However sound in theory a sinking fund may be, it is the *mode of investment, its administration,* which is the vital point. Expense, too, lurks in the prolonged interest account which taxation must meet annually, and which must also meet any deficiency in the sinking fund.

The suspension of a sinking fund is at times deliberate, and is essential in sound finance if money must be borrowed to maintain it; for to borrow to keep up the sinking fund is a purely fictitious operation, which really adds to the debt it in no wise reduces. England suspended the sinking fund in 1886-87, after the war in Egypt, and again more recently on account of the Transvaal war,

reliance being placed upon the nation's credit for the final liquidation of these debts.[6]

In England the successive failures of sinking funds, it is said, "made the term Sinking Fund almost one of reproach."[7]  Again:

> In 1816 a Sinking Fund was commenced in France, on the principle of Mr. Pitt's English one.  It has long since ceased to produce any effect but that of creating confusion in the accounts.[8]

> In time of peace, it [the sinking fund] has no efficacy beyond that which would result from applying the surplus revenue to an equal amount in the redemption of the debt; and in time of war, when more debt is contracted than is paid off, it ceases to have any efficacy whatever, and only serves to increase the burdens of the people when they are least able to bear them, not only by the expense attending one per cent of taxes raised, but by the expense attending the execution of the plan.[9]

As late as 1869, from England came astonishing revelations, proved by a parliamentary committee, to the effect that:

> Estimated as a net result of the sinking fund system kept up during war, the nation had, between 1785 and 1829, borrowed £330,000,000 at about 5 per cent interest, in order to pay a debt of the same magnitude at 4 ½ per cent interest.  This policy, by which a debt of 4 ½ per cent was converted into one of 5 per cent, meant *an annual loss of interest of £1,627,765 extending over forty-three years.*[10]

Equal to a total loss of £69,993,895 or $338,770,427!

During our Civil War the United States did not make that mistake, for although the Act of 1862, authorizing legal-tender notes, provided for a sinking fund of 1 per cent, yet:

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[6] Trinquat, *De l'Amortissement des Emprunts d'Etats* (Paris, 1899), p. 388; Raffalovich, "Review of the World's Financial Affairs," *Journal des Economistes,* January, 1903; *Journal of Commerce and Commercial Bulletin* (New York), February 3, 1903; E. A. Ross, "Sinking Funds," *Publications of the American Economic Association,* vol. VII (1892), pp. 92, 103.

[7] Sargant, *Sinking Funds* (London, 1868), p. 82.

[8] *Ibid.,* p. 131.

[9] "Errors in our Funding System," *Edinburgh Review,* January, 1823, pp. 1, 11, 12.  "It is probable that in many cases the use of a sinking fund is an altogether unwarrantable draft drawn upon the future, because there is no reasonable certainty that the fund, whether it be state, municipal, or commercial, will not be raided before it attains its object." (P. D. Leake, *The Use and Misuse of the Sinking Fund.*)

[10] Ross, "Sinking Funds," *Publications of the American Economic Association,* vol. VII (1892), pp. 17, 18; Lalor, *Cyclopedia of Political Science,* vol. III, p. 720.

During the war no attempt was made to fulfill this pledge, as the government was continually borrowing and adding to its total indebtedness.[11]

Or, as stated by John Sherman:

While the United States was borrowing large sums and issuing bonds, it was folly to pay outstanding bonds, and this was not done until 1868, when the Treasury was receiving more money than it disbursed.[12]

The late Professor Dunbar, of Harvard University, in his *Economic Essays* (1904 ed., p. 84 *et seq.*), referring to Mr. Pitt's famous sinking fund system which was swamped by the gigantic wars of the French Revolution, affirms that it rested "upon a complete illusion as to the possibility of holding Parliament permanently to the system—as to the possibility, that is, of binding the debtor by a compact made with himself." On the other hand, Alexander Hamilton, following Pitt, hoped for an adequate surplus revenue to sustain his system, which "was made useless by the astonishing growth of national revenue" (p. 89). So after our Civil War the wonderful prosiliency of the nation swept aside the sinking fund requirements of the congressional act of 1862, reducing them to a mere perfunctory bookkeeping entry.

For many years the state of Massachusetts far outranked any other state in the Union in the magnitude of its state debt. On September 30, 1913, its funded debt was $117,838,412. Its sinking funds were $34,674,498. Again, the gross debt, with interest obligations (metropolitan, municipal, state, and county), resting upon the Metropolitan District of Boston and vicinity alone—39 municipalities out of 353 in the state—is about $400,000,000, on about 400 square miles of territory, or about one twentieth the area of the state. Such a debt—of national proportions—has caused serious study of the operation of sinking funds. Massachusetts, although permitting the optional use of "serial bonds" since 1882 (*Acts of 1882*, ch. 133) finally in 1913 (*Acts of 1913*, ch. 719, sec. 13) prohibited sinking funds for municipal loans, and made the "serial bond" method compulsory for such loans: thus causing all its municipal indebtedness "to be issued upon the same salutary and equitable basis as that already adopted by the Commonwealth" (House Doc. No. 2162, 1913, p. 25). In this respect Massachusetts is supposed to lead the world.[13] Prior

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[11] Dewey, *Financial History of the United States*, p. 356.

[12] Sherman's *Recollections*, vol. II, p. 876.

[13] It may be observed that West Virginia, by its constitution of 1872, art. X, sec. 4, expressly provided for payments of the debt as under the serial bond method as follows: "The payment of any liability other than that of the

to this the present new city charter of Boston (*Acts of 1909*, ch. 486, sec. 26) provided that all loans issued by that city shall be made payable in annual instalments, and that no sinking fund shall be established for any loan. The sinking fund method is now abandoned, as a financial anachronism, out of date, unreliable, too costly, and to be discarded in advanced municipal finance. Certain transit bonds of the city of Boston are specially provided for under *Acts of 1910*, chapter 437 and *Acts of 1911*, chapter 165.

Recent investigations made (under ch. 11, *Resolves of 1912*) by Hon. C. F. Gettemy, the director of the Bureau of Statistics of Massachusetts, of the sinking funds and serial loans of the municipalities of that state (House Doc. No. 2162, 1913), involved calculations of some 1,200 municipal sinking funds (not including about $42,000,000 in the sinking funds of Boston), and revealed net apparent deficiencies in 40 cities and towns aggregating $1,794,391.58, and net apparent surpluses in 47 cities and towns aggregating $2,855,192.37. Hence the legislation that followed (*Acts of 1913*, ch. 719, sec. 13) prohibiting sinking funds in Massachusetts for municipal loans.

Last winter it was discovered that the citizens of the state of New York had been taxed for sinking funds nearly $19,000,000 ($18,773,045.57) in excess of the amount required under a scientific bond amortization plan. This extraordinary overtax appears to have progressed through four administrations, and grew out of an erroneous and mistaken policy pursued by those managing that feature of the state's business. It was estimated that the continuance of this huge accumulation of unnecessary moneys would ultimately have amounted to a sum in excess of the whole amount of authorized bond issue of $234,000,000![14] This astonishing error would still have its overmatch in the revelations of the English parliamentary committee mentioned above, where the sinking fund mismanagement meant a total loss in 43 years of $338,770,427!

If the principles of scientific accounting now applicable to local government in Massachusetts could be brought to bear at large, astonishingly lax and ineffective methods would be exposed, as

ordinary expenses of the State, shall be *equally distributed* over a period of at least twenty years."

[14] *Tribune, Sun,* and *Times* (New York), February 10, 11, 1913.

they have been with many public sinking funds in that state. If, already, an overtax of nearly $19,000,000 has been enforced for some recent New York state sinking fund bonds, where that state's bonded debt was (Apr. 23, 1912) $108,055,660, what might not be disclosed with the very many sinking funds of New York city, totalling $304,860,242, and whose gross funded debt, April 1, 1913, was $1,137,211,854, or more than the interest bearing debt of the nation?

The New York News Bureau (June 23, 1905) affirmed that:

The provision of a sinking fund has usually been considered as an abundant safeguard for bond investors. Experience, however, shows there have been many exceptions. The most frequent reason for the receiverships of railway companies is the failure to pay the interest on mortgage bonds. During 25 years, up to 1898, more than 700 railroad companies, with a mileage exceeding 100,000 miles, and representing about $3,000,000,000 in capital stock and bonded indebtedness, had been put into receiverships, notwithstanding the common practice of creating sinking funds for many of them.

About the year 1880 the Boston sinking funds were despoiled of $82,000.[15]  In 1904, $292,000 were reported as taken from Boston's sinking funds for current expenses in an exceptional way.[16]  In 1909 the sinking fund of the city of Lynn, Mass., was reported as about $400,000 short.[17]  The city's sinking funds in Chicago have been reported as generally taken for current expenses.

It has been said that "no part of the commission administration of Des Moines, Iowa, is more brilliant than its financial record." (*Nat. Munic. Rev.*, Oct., 1912, p. 723). But an expert analysis of Des Moines' finances revealed a shortage in its interest and sinking fund appropriations of $438,827.77, and affirmed that the new commission government had continued to impose inadequate tax levies, falling, in 1909, "far short of yielding even the current interest charge to say nothing of making the proper sinking fund provision." By that analysis it also appears that "the new government like the old has systematically evaded its moral obligation, and is playing fast and loose with the city's credit. On a tax valuation of $19,551,000, the levy for interest and sinking fund purposes during 1910 should have been 5.9 mills instead of 2.6 mills" (*Nat. Munic. Rev.*, Apr., 1912, pp. 177, 178).

[15] *Auditor's Report,* Boston, 1880-81, p. 7.
[16] *Boston Transcript,* August 15, 1904, but see *Acts of 1903,* ch. 191, §2.
[17] *Boston Herald,* June 7, 9, 1909.

If Massachusetts' lead is followed, forbidding sinking funds for new public loans, a normal result may well be the readjustment or refunding, from time to time, and as conditions permit, of large amounts of outstanding public sinking fund bonds.

The readjustment of both state and municipal sinking fund bonds, or of a large part of them, throughout the nation, into state or municipal serial, convertible consols ("early convertability" being the American policy), or otherwise, is in order; not forcibly, without the consent of the bondholders, as tried in Virginia, but by the voluntary coöperation of both borrower and lender, and to their mutual advantage, as will now appear.

Mr. Turner summarizes the three methods of repaying loans in table 1 on the following page.

This table is for only £1,000 and for only 10 years' time. Yet the difference in the *interest* charges between the three methods is:

|   |   | Interest | Difference in interest |
|---|---|---|---|
| 1. | Instalment method ....................... | £275. | |
| 2. | Annuity method ......................... | 295.10 | £20.10 |
| 3. | Sinking fund method ..................... | 500. | 225. |

The difference in the *cost* of the £1,000 loan to the borrower is:

|   |   | Total cost | Difference in cost |
|---|---|---|---|
| 1. | Instalment method ...................... | £1275. | |
| 2. | Annuity method ........................ | 1295.11 | £20.11 |
| 3. | Sinking fund method (basis of 5 per cent).... | 1295.11 | 20.11 |
|   | 5 per cent is too high; 3½ per cent is safer,[22] which gives approximately: | | |
| 4. | Sinking fund method (basis of 3½ per cent) | 1352.+ | 77.+ |

Bearing in mind the magnitude of modern fiscal and financial operations, a deeper impression is made if in the above tables for £1,000 we read £1,000,000, and assume a proportional ratio of

[22] In Massachusetts it is the practice to base the computations for sinking funds "on the assumption that the funds should earn 3½ per cent annually, this being deemed a conservative figure as the basis of a uniform computation" (House Doc. No. 2162, 1913, p. 16). In Canada it is claimed to be "unsafe to calculate on the sinking fund earning more than Savings Bank interest." (*Macpherson's Municipal Accounting,* p. 41.)   Mr. Turner himself affirms (p. 148) that for long-time bonds "it is very difficult, if not impossible" to fix an average rate per cent correctly for accumulations for long periods, and adds that "the practice generally is to assume a rate of accumulation slightly lower than the rate of interest payable to the loan holders." He then illustrates by numerous solutions on a 3½ per cent basis.

Table 1.—The repayment of the debt of local authorities: general summary of all methods, showing the annual charge to revenue or rate in respect of a loan of £1,000 repayable in 10 years under the instalment, annuity and sinking fund methods.

| | Instalment method | | | Annuity method | | | Sinking fund method | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Principal | Interest | Total | Principal | Interest | Total | Principal | Interest | Total | Year |
| 1 | £100 | £50 | £150 | £79.51 | £50. | £129.51 | £79.51 | £50 | £129.51 | 1 |
| 2 | 100 | 45 | 145 | 83.49 | 46.02 | 129.51 | 79.51 | 50 | 129.51 | 2 |
| 3 | 100 | 40 | 140 | 87.66 | 41.85 | 129.51 | 79.51 | 50 | 129.51 | 3 |
| 4 | 100 | 35 | 135 | 92.05 | 37.46 | 129.51 | 79.51 | 50 | 129.51 | 4 |
| 5 | 100 | 30 | 130 | 96.65 | 32.86 | 129.51 | 79.51 | 50 | 129.51 | 5 |
| 6 | 100 | 25 | 125 | 101.48 | 28.03 | 129.51 | 79.51 | 50 | 129.51 | 6 |
| 7 | 100 | 20 | 120 | 106.56 | 22.95 | 129.51 | 79.51 | 50 | 129.51 | 7 |
| 8 | 100 | 15 | 115 | 111.88 | 17.63 | 129.51 | 79.51 | 50 | 129.51 | 8 |
| 9 | 100 | 10 | 110 | 117.48 | 12.03 | 129.51 | 79.51 | 50 | 129.51 | 9 |
| 10 | 100 | 5 | 105 | 123.24 | 6.27 | 129.52 | 79.51 | 50 | 129.51 | 10 |
| | £1000 | £275 | £1275 | £1000. | £295.10 | £1295.11 | £795.10 | £500 | £1295.10 | |

increase in the interest and in the cost to the taxpaper or borrower, the result then being, for £1,000,000 for 10 years:

|     |                         |          |    Difference  |
|-----|-------------------------|----------|----------------|
|     |                         | Interest | in interest    |
| 1.  | Instalment method ......................£275,000 |  |   |
| 2.  | Annuity method ......................... | 295,100 | £20,000 |
| 3.  | Sinking fund method.................... | 500,000 | 225,000 |

|     |                         |            |  Difference  |
|-----|-------------------------|------------|--------------|
|     |                         | Total cost | in cost      |
| 1.  | Instalment method .....................£1,275,000 |  |  |
| 2.  | Annuity method ........................1,295,100 |  | £20,110 |
| 3.  | Sinking fund method (5 per cent basis).....1,295,100 |  | 20,110 |
| 4.  | Sinking fund method (3½ per cent basis)...1,352,000 |  | 77,000 |

The next table summarizes numerous computations verified by a public accountant and submitted to Massachusetts officials and to the general public, in connection with legislation in that state on sinking funds and serial bonds. Coupled with the prudential reasons that as a rule prohibit the general adoption of the sinking fund method, the application of the following table to large operations at once justifies the rejection of Mr. Turner's conclusion that the sinking fund method is "by far the best."

Table 2.—*Serial bond and sinking fund methods contrasted.*

| | $1,000,000 at 3 per cent Difference in INTEREST in favor of serial bonds | | | $1,000,000 at 4 per cent Difference in INTEREST in favor of serial bonds | | |
|---|---|---|---|---|---|---|
| | 20 Years | 40 Years | 50 Years | 20 Years | 40 Years | 50 Years |
| | $285,000 | $585,000 | $735,000 | $380,000 | $780,000 | $980,000 |
| | Difference in COST in favor of serial bonds | | | Difference in COST in favor of serial bonds | | |
| Sinking Fund | 20 Years[1] | 40 Years[2] | 50 Years[3] | 20 Years[1] | 40 Years[2] | 50 Years[3] |
| Or. 3 per cent basis | $19,426 | $109,199 | $173,305 | $114,426 | $304,199 | $418,305 |
| " 3½ " " | ........ | 51,791 | 111,908 | 76,483 | 246,791 | 356,908 |
| " 4 " " | ........ | ........ | 58,057 | 40,231 | 194,765 | 303,057 |

[1] Decimal for 19 years, and 19 payments.
[2] Decimal for 39 years, and 39 payments.
[3] Decimal for 49 years, and 49 payments.

If the number of payments were to equal the full number of years, there would be an increase over the above in the saving in favor of serial bonds, the ratio of such increase being larger with the bonds of a shorter term.
If both the decimal taken and the number of payments made each equal the full number of years, there will still be a large gain in favor of the serial bonds.

The point is sometimes raised against serial bonds that *if* a taxpayer can employ his money at a higher rate per cent than is charged for the loan under the sinking fund method, that is *if* he can earn say 6 per cent with his money and pays 4 per cent for the loan, his profit is 2 per cent on the sinking fund method pending the life of the loan, which profit the serial bond method would, it is assumed, prevent or impair.

A sufficient answer to this appears in an editorial thereon in "The Commercial and Financial Chronicle" (New York, December 23, 1895, p. 1759), which shows that if such an argument based on the value of money to the taxpayer were to be carried to its logical extreme, it would lead to wholly untenable grounds; for if the argument is admissible at all, why could it not with equal plausibility be urged against ever paying off the bonds? Why not let them run indefinitely? The taxpayer would then be relieved from all concern as to the extinguishment of the loan. In comparing the two methods, extraneous considerations of such a nature must, as the editor makes clear, be entirely excluded from the calculation. The assumption that each taxpayer, out of possible thousands, would get say 6 per cent for his proportion of the difference between the two methods is an irrelevant hypothesis. Again, one taxpayer might misuse or lose his entire share; another contrive to get 10 per cent or 20 per cent on his share. The obvious diversities of such an adventitious conjecture help to preclude its application to the main question.

In this connection it may be observed that after a certain period the serial bond requires the annual payment of *less* money than the sinking fund method, so that thereafter, on the score of possible interest profit to the taxpayer, the situation becomes reversed and the result ultimately is in favor of serial bonds. Thus table 3 demonstrates year by year, how a $1,000,000 twenty-year 4 per cent serial bond compares in cost with a $1,000,000 twenty-year 4 per cent sinking fund bond, the sinking fund being on a $3\frac{1}{2}$ per cent basis; compound interest is allowed also at $3\frac{1}{2}$ per cent on the differences in the annual contributions between the two methods; and the final saving in favor of the serial bond method is $59,133.02.

Table 3.—*Comparison between serial bond and sinking fund methods—$1,000,000 at 4 per cent for 20 years.*

| Years | Serial bond method 1/20 payable each year | | Sinking fund method, 3½ per cent basis | Difference in favor of Serial method | Difference in favor of Sinking fund method | Interest on difference at 3½ per cent compounded |
|---|---|---|---|---|---|---|
| 1 | Prin. $50,000 Int. 40,000 | $90,000 | $76,657[1] | | $13,343  19 ys. | $12,308.91 |
| 2 | 50,000 38,000 | 88,000 | 76,657 | | 11,343  18 " | 9,726.50 |
| 3 | 50,000 36,000 | 86,000 | 76,657 | | 9,343  17 " | 7,424.69 |
| 4 | 50,000 34,000 | 84,000 | 76,657 | | 7,343  16 " | 5,389.68 |
| 5 | 50,000 32,000 | 82,000 | 76,657 | | 5,343  15 " | 3,608.39 |
| 6 | 50,000 30,000 | 80,000 | 76,657 | | 3,343  14 " | 2,068.28 |
| 7 | 50,000 28,000 | 78,000 | 76,657 | | 1,343  13 " | 757.39 |
| | | | | | | $41,283.84 [2] |
| 8 | 50,000 26,000 | 76,000 | 76,657 | $  657  12 ys. | | $335.77 |
| 9 | 50,000 24,000 | 74,000 | 76,657 | 2,657  11 " | | 1,222.14 |
| 10 | 50,000 22,000 | 72,000 | 76,657 | 4,657  10 " | | 1,912.16 |
| 11 | 50,000 20,000 | 70,000 | 76,657 | 6,657  9 " | | 2,415.82 |
| 12 | 50,000 18,000 | 68,000 | 76,657 | 8,657  8 " | | 2,742.62 |
| 13 | 50,000 16,000 | 66,000 | 76,657 | 10,657  7 " | | 2,901.68 |
| 14 | 50,000 14,000 | 64,000 | 76,657 | 12,657  6 " | | 2,901.74 |
| 15 | 50,000 12,000 | 62,000 | 76,657 | 14,657  5 " | | 2,750.97 |
| 16 | 50,000 10,000 | 60,000 | 76,657 | 16,657  4 " | | 2,457.24 |
| 17 | 50,000 8,000 | 58,000 | 76,657 | 18,657  3 " | | 2,028.38 |
| 18 | 50,000 6,000 | 56,000 | 76,657 | 20,657  2 " | | 1,471.39 |
| 19 | 50,000 4,000 | 54,000 | 76,657 | 22,657  1 " | | 792.95 |
| | | | | | | $23,933.86 [2] |
| 20 | 50,000 2,000 | 52,000 | 40,000 | | 12,000 | |
| | | $1,420,000 | $1,496,483 1,420,000 | $139,884 63,401 | $63,401 | |

Saving by serial bond method...... $76,483     $76,483
Deduct interest saving in favor of sinking fund ................ 17,349.98

Final saving in favor of serial bond method ...................... $59,133.02

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[1] Sinking fund $36,657
Interest      40,000
          ————
          $76,657

[2] Interest on sinking fund differences  $41,283.84
[2] Interest on serial bond differences    23,933.86
                                          ————
Interest saving in favor of sinking fund  $17,349.98

Two objections to the serial bond—unpopularity and a high
rate of interest—have practically vanished. The advantages
of serial bonds to both borrower and lender are now recognized
far and wide, and appertain to loans of hundreds of millions of
dollars, including industrial as well as public loans. The money
market is now too broad, elastic, and responsive to be cramped by
the narrower view of the last century.

A third objection to serial bonds has been the larger initial pay-
ments required in the earlier years of the loan. Some wish to avoid
these in order to put more rather than less of a burden upon their
successors. But, in the majority of progressive municipalities,
successors of today have far more to bear than their predecessors
who could have borne more. The generation to come will have its
full share of new tax burdens. The debt incurring tendency is to
be restrained by a present liability, rather than encouraged by
shifting that liability to a later generation. Moreover, our "suc-
cessors" are, for a large part, to be *ourselves;* for taxpayers of
today between 25 and 40 years of age must still be meeting many
present outstanding long-time bonds when from 55 to 70 years of
age. The "successor" excuse is not altogether municipal pru-
dence; rather a costly evasion. Again, serial bonds can be paid in
equal annual payments as to both principal and interest, or by
the "annuity plan." This is more expensive than by the "instal-
ment plan," though less expensive than by the sinking fund plan.
Thus: $1,000,000 at 4 per cent for 20 years costs:

1. By the instalment plan (serial bond).............$1,420,000
2. By the annuity plan (serial bond)............... 1,471,635
3. By the sinking fund plan (3 ½ per cent basis).... 1,496,483

The principles herein involved are better understood now, and
are more highly appreciated even though more clerical labor and
more changes in investments are incident to serial bonds. Safety
for both creditor and debtor is now recognized as controlling. A
modern banking house[23] tersely summarizes the merits of serial
bonds, for private and for public corporations, thus:

"WHEN A BOND ISSUE IS SERIAL, THE INVESTMENT
GROWS SAFER AS IT GROWS OLDER."

[23] Peabody, Houghteling & Co., Chicago, Ill.

The striking contrast between the operation of serial bonds and sinking fund bonds was emphasized in tabular statements drawn to the attention of state treasurers of Massachusetts, pending official consideration of this subject. It was thereby shown that the difference in the *interest* account between the sinking fund and the serial bond methods for the three main items, about $56,000,- 000 of forty year bonds, of the state contingent debt—park, sewerage, and water—would be about *twenty-six millions of dollars,* even if the bonds had been issued in serial form at a one half per cent *higher* rate than under the sinking fund form! Also that the difference in the actual *cost* to taxpayers, between the two methods, would be about $8,360,000 on a 3½ per cent basis. Naturally these extraordinary exhibits have stimulated the consideration of refunding many existing public sinking fund bonds into serial bonds even if at a higher rate per cent, provided suitable legislation therefor in the respective states be first obtained.

Tables 4 and 5 that follow give in detail a demonstration of the above statement as to the approximate principal sum of $56,000,000.

Table 4.—*Massachusetts state contingent debt, as of December 10, 1902, excepting Armory loan of $1,893,000.*

| | 3 per cent | 3½ per cent | Total | Interest | Premiums |
|---|---|---|---|---|---|
| Sewerage ... | $7,989,912 | $2,980,000 | $10,969,912 | $13,270,652 | $370,813 |
| Parks ...... | 2,680,000 | 8,350,000 | 11,030,000 | 14,826,000 | 739,160 |
| Water ...... | 10,900,000 | 23,600,000 | 34,500,000 | 45,532,875 | 2,300,487 |
| | $21,569,912 | $34,930,000 | $56,499,912 | $73,629,527 | $3,410,460 |
| | | | | 3,410,460 | |
| | | | | $70,219,067 | |
| | | | | 56,499,912 | |
| | Total, principal and interest......... $126,718,979 | | | | |

If the above 40-year sinking fund, 3 per cents had been issued as serial 40-year bonds at 3½ per cent, and the above 40-year, sinking fund, 3½'s had been issued as serial 40-year bonds at 4 per cent, the difference in interest between the sinking fund method and the serial bond method, even with that increase of interest rate, would be:

|  |  |  | Interest | Principal and interest |
|---|---|---|---|---|
| **Principal** | | | | |
| $21,569,912 | 3% 40 yr. | } (Sinking fund) | $70,219,067 | $126,718,979 |
| 34,930,000 | 3½% " " | | | |

(1) $56,499,912

|  |  | Interest |  |  |
|---|---|---|---|---|
| $21,500,000 | 3's at 3½%, 40 yr. 1/40 each year | $15,426,240 | | |
| 35,000,000 | 3½'s at 4%, 40 yr. 1/40 each year | 28,700,000 | | |
| (2) $56,500,000 | | | 44,126,240 | |
| | | | | $100,626,240 |

Difference in INTEREST in favor of
serial bonds ...................... **$26,092,827**

But even if the above $56,000,000 (using round numbers) is so successfully financed by the sinking fund method as to pay the principal of the debt at the end of 40 years, yet it is a more expensive method than the serial bond method (due to the difference in interest), whether the sinking fund is based upon a 3½ per cent on 4 per cent or even 5 per cent basis, as appears by the following table, computed by the Robinsonian sinking fund tables, and any excess of such expense involves corresponding additional hazard.

Table 5.

|  | 3½% basis Decimal for $1 for sinking fund being .011969 for 39 years[1] | 4% basis Decimal for $1 for sinking fund being .010635 for 39 years[1] | 5% basis Decimal for $1 for sinking fund being .008347 for 39 years[1] |
|---|---|---|---|
| $56,000,000 sinking fund requirements for 40-year loan | $26,140,296 | $23,226,840 | $18,229,848 |
| $56,000,000 for 40-years' interest at 3½ per cent | 78,400,000 | 78,400,000 | 78,400,000 |
| Cost of loan by sinking fund method | $104,540,296 | $101,626,840 | $96,629,848 |
| $56,000,000 40-year serial bonds, 1/40 payable yearly $56,000,000 Interest (annually diminishing) at 3½ per cent 40,180,000 Cost of loan, serial bond method $96,180,000 | 96,180,000 | 96,180,000 | 96,180,000 |
| Difference in COST in favor of serial bond method | **$8,360,296** | **$5,446,840** | **$449,848** |

[1] Thirty-nine years, instead of forty, is taken for the decimal, because one year is allowed for the practical operation of the sinking fund; following the practice at the Boston City Hall.

Such data have aroused a strong normal interest in the readjustment or refunding of many outstanding public sinking fund bonds, as the responsive field offering therefor is promising and large, such readjustment or refunding being quite possible for the mutual advantage of both borrower and lender through appropriate legislation that recognizes a voluntary coöperation on their part.

Two kinds of sinking funds are noticed by our courts: a real sinking fund, and a pseudo sinking fund. The first is intended ultimately to extinguish a certain indebtedness; the second is designed to allure purchasers of bonds by holding out a security that is such in appearance only and not in reality. If the first, which is based upon integrity, but is so often exposed to maladministration and to the many contingent problems that Mr. Turner evolves, and may, in the case of public loans, be subject for decades to political vicissitudes and control, has become, for public loans, a subject for legislative suppression, *a fortiori* ought the second, or deceptive kind, to come under vigorous treatment or fall into disuse. "The mere retention in hand of sums out of revenue for any purpose does not constitute a sinking fund; there must be a specific investment of money intended to accumulate at interest."[24]

"The best way to sink a debt is to pay it; the surest sinking fund is *payment*."[25]

ALFRED D. CHANDLER.

*Brookline, Massachusetts.*

[24] P. D. Leake, *The Use and Misuse of the Sinking Fund.*

[25] George Morgan Browne, *The Sinking Fund* (2d ed., 1880), p. 10. Mr. Browne was at one time president of the Eastern Railroad. See also "New York City Finances," by W. H. Prendergast, comptroller, in *National Municipal Review,* April, 1913, pp. 221, 229.